CAN HIGH PLASTIC RECYCLING RATE TARGETS BE REACHED WITHOUT POSING A RISK TO HUMAN HEALTH?

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The EU Strategy for Plastics in a Circular Economy requires a drastic increase of the plastic recycling rate in the upcoming decade - from currently less than 30% of the plastic waste being collected for recycling up to more than 50% being recycled in 2030 (European Comission 2018). If the worldwide growth in plastic consumption continued as projected, by 2100 emissions from plastics production and end-of-life treatment could use up to one third of the entire available carbon budget which is compatible with a 2°C scenario (Enkvist and Klevnäs 2018). A higher recycling rate as envisaged can be beneficial for the environment, if high-quality secondary material can substitute primary production, but it can at the same time pose risks to human health and ecosystems. Such risks can arise from residual amounts and potential accumulation of additives in the secondary granulate, as well as their transformation and release during recycling processes. To increase the recycling rate while guaranteeing protection of human and environmental health, which system changes would be necessary and viable? Which waste streams would need to be directed to final sinks?

To answer these questions, knowledge on the current and future plastic waste streams, as well as technological developments and system properties is required. Such knowledge allows identifying material streams suitable for increased recycling as well as implementable system changes for reaching such an increase. In order to quantify and characterize current and future waste streams, a dynamic material flow analysis for plastics in Switzerland has been conducted, focusing on linking the disposal stages with product manufacturing. The system boundary included the production, use and recycling/disposal phases of all main segments from which plastic waste arises (European Comission 2018), e.g. packaging, electrical and electronic equipment and building and construction. This wide perspective allows identifying the segments offering the biggest potential for increased recycling as well as interlinkages between segments, i.e. secondary material of one segment being used in another segment.

The segments offering a potential for increased recycling have been identified using different criteria. First, the current and future waste volumes of different applications, as well as their composition (plastic types and additives) constitute important factors. Composition may change over time, and former plastics compositions may still be relevant in case of long appliance lifetimes, which has been considered. Second, current recycling practices and applications in which the recyclate is used, the availability of alternative sorting and recycling methods and the maturity of emerging technologies are relevant aspects for the potential of future recycling. In this context, also additive removal technologies have been investigated. Another parameter determining recyclability is product design, e.g. how different materials are attached to each other. The probability for a future change in product design, which can occur due to technological innovation or based on aligned design guidelines for specific segments as proposed by wrap (2018), has been considered in the assessment. Recycling obstacles of economic and psychological nature, such as missing profitability and consumer acceptance, and the possibility of overcoming such constituted another criterion.

The determination of material streams suitable for increased recycling goes hand in hand with the identification and quantification of flows which are either difficult to recycle or shall not be recycled. Recycling can be inhibited by material mixes, which cannot be separated by the current and expected future sorting and recycling technologies. The reason for purposely not recycling certain material streams is the avoidance of the accumulation of harmful additives that may pose a risk to human health and the environment. Hazardous additives will remain to be present in the future waste streams as they are either currently still being used, or have been used in the past in long-living appliances. They play a crucial role in the determination of streams that need to be removed from the system. For the respective streams, final sinks guaranteeing health protection have been identified.

To reach a transition of the material flow system to a state involving higher recycling rates for the segments with potential for increased recycling, different system parameters need to be changed. The required changes have been identified and include i) increased collection, ii) improved collection, e.g. by product marking and sorting by the consumer into food and non-food items, enabling the production of recyclate for food-contact applications as shown by the example of PET bottle recycling in Switzerland, iii) the application of available technologies for material identification and separation, as well as for tracing the material origin, iv) increased transparency regarding plastic waste composition, and v) provision of economic or regulatory incentives.

References

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